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| 10/025,595 | 12/18/2001 | Peter J. De Groot | 09712-055001 / Z-200 | 7937 |

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| ART UNIT | PAPER NUMBER |
|---|---|
| 2877 | |

DATE MAILED: 06/04/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/025,595 | DE GROOT, PETER J. | |
| | Examiner | Art Unit | |
| | Andrew H. Lee | 2877 | pw |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *17 March 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-10,12-28 and 30-64* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10,12-28 and 30-64* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

### *Allowable Subject Matter*

1. The indicated allowability of claims **9-11, 23, 28, 37-39, and 52** is withdrawn in view of the newly discovered reference(s) to Boppart. Rejections based on the newly cited reference(s) follow.

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-10, 12-24 rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson (US 6,392,752) in view of McCullough and further in view of Boppart et al (US 6,485,413).

For **claim 1**, Johnson (Johnson '751 hereinafter) shows phase-measuring microlens microscopy comprising:

directing a measurement beam (column 3, lines 51+) to contact a measurement surface (106) and a reference beam to contact a reference surface (M), wherein the measurement and reference beams are derived from a common source (109);

imaging light (column 3, lines 47+) reflected from the measurement surface onto a multi-element detector (103) through an optical system comprising a microlens array (102); and

imaging light (column 3, lines 65+) reflected from the reference surface (M) onto the multi-element detector to interfere with the light reflected from the measurement

surface.

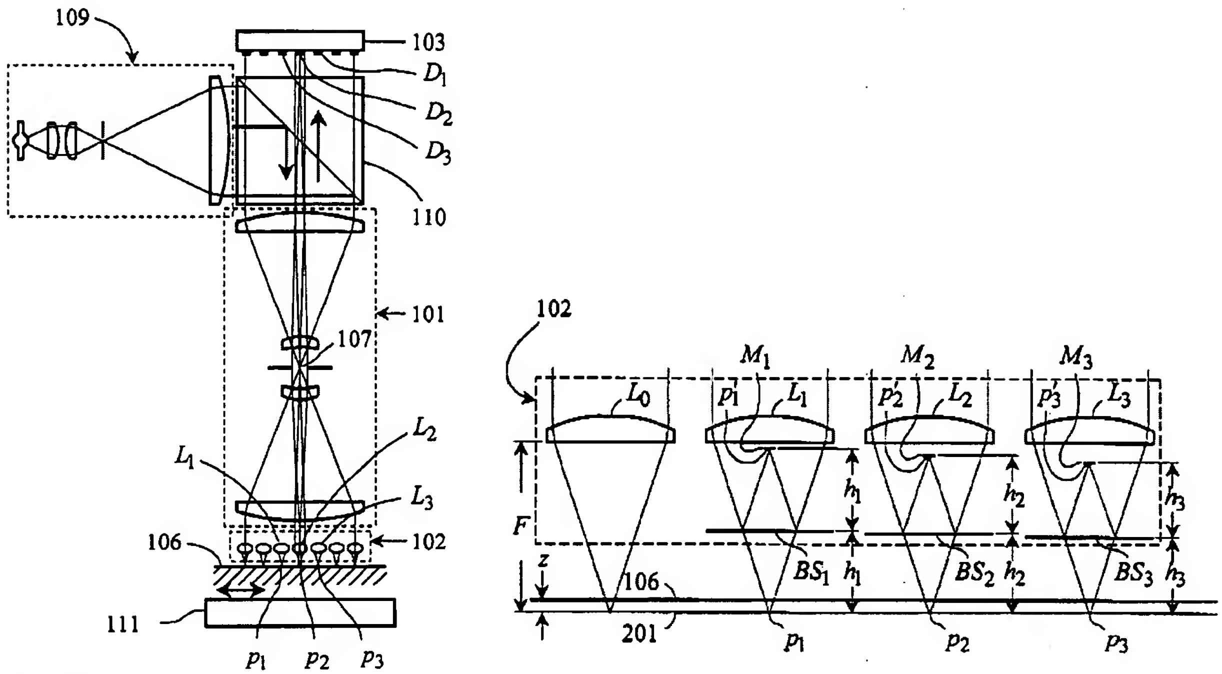


**Fig 1**

Johnson '752 does not expressly say that the microlens array has an array of lenslets. McCullough et al (McCullough et al hereinafter) shows an illumination system and teaches that a microlens array comprises an array of lenslets. Therefore, at the time of the invention, one of ordinary skill in the art would have constructed the microlens array to have an array of lenslets in order for each lenslet to refract the light in the desired direction.

Furthermore, Johnson '752 does not expressly show the imaging with a magnification of less than 1.

Boppart et al show a method and apparatus for interferometric forward-directed optical scanning instruments wherein Boppart suggests the use of microlens array or group of lens for relaying and magnifying or demagnifying the image (column 31, lines 24+).

At the time of the invention, one of ordinary skill in the art would have been motivated to modify Johnson '752 so that the image is imaged with a magnification of less than 1 (demagnify), including magnifying the image or relaying with no magnification the image as currently shown by Johnson '752. One of ordinary skill in the art would have done so in order to image a larger portion of the sample with demagnification or image a smaller portion of the sample with greater detail with magnification, thus being able to image the required portion required detail of the sample.

As for **claim 2**, the lenslet array (102) is positioned to generate a virtual image of the measurement surface in a virtual image plane (surface of detector 103).

As for **claim 3**, the optical system further comprises a detector imaging system (101, 110) for imaging the virtual image in the virtual image plane onto the detector.

As for **claim 4**, the optical system further comprises an object imaging system (101, 102) for imaging the measurement surface onto an intermediate image plane (at 107) adjacent the lenslet array.

As for **claim 5**, the object imaging system comprises a telecentric relay (101).

As for **claim 6**, Johnson '752 shows combining (column 4, lines 16+) the light reflected from the measurement surface with the light reflected from the reference surface and directing

the combined light towards the lenslet array through the object imaging system.

As for **claim 7**, the object imaging system images the reference surface onto the intermediate image plane to overlap with the image of the measurement surface.

As for **claim 8**, the lenslet array is positioned to generate a virtual image of the reference surface in the virtual image plane to overlap with the virtual image of the measurement surface, and wherein the detector imaging system images the overlapping virtual images of the measurement and reference surfaces onto the detector.

As for **claim 13**, the optical system is selected to cause each element of the lenslet array to couple incident light reflected from the measurement object to a different one of the detector elements (column 3, lines 39-42).

As for **claim 14,** the lenslet array comprises an array of refractive elements (L) each having focusing power.

As for **claim 16**, the lenslet array comprises an array of diffractive elements each having focusing power (column 4, lines 5+).

As for **claim 17**, Johnson '752 measures an intensity signal at each of the detector elements (column 3, lines 39+) and determining a surface profile (column 2 lines 53+) of a measurement object based on the measured signals.

As for **claim 20**, Johnson '752 shows directing an input beam from the source into the lenslet array to produce an intermediate beam comprising an array of sub-beams; and separating (BS) the intermediate beam into the measurement and reference beams, wherein the lenslet array is positioned to cause the measurement beam to contact the measurement surface as an array of focused spots corresponding to the array of sub-beams (column 4, lines 5-20).

As for **claim 21**, the lenslet array is positioned to generate a virtual image of the measurement surface in a virtual image plane (plane at 107), wherein each element of the lenslet array images a region of the measurement object corresponding to a different one of the array of focused spots (column 3, lines 43+).

As for **claim 22**, Johnson '752 does not expressly say that the numerical aperture of the lens system matches an objective numerical aperture of the lens system for illuminating the interferometer to an image numerical aperture of the lens system for imaging the optical interference onto the detector, however, it would be obvious to one of ordinary skill in the art to arrange the apparatus so that the numerical aperture of the lens system matches an objective numerical aperture to an image numerical aperture based on the arrangement of Figure 1, and that Johnson '752 says each microlens is imaged on each detector pixel (column 3, lines 38+)

where the projection aperture (107) is conjugate to the microlens focal points (column 4, lines 41+).

1. **Claim 12** is rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson '752 and McCullough as applied to claim 1 above, and further in view of Cohen et al (US 5,133,601).

Johnson '752 and McCullough show all the limitations as described above but do not expressly show that the surface of the sample being profiled is diffusely reflective.

Cohen et al show a Mirau interferometer for profiling rough surface.

At the time of the invention, one of ordinary skill in the art would have been motivated to use the combined apparatus of Johnson '752 and McCullough to measure the surface profile of a rough surface which is diffusive since a rough surface is not specular. The artisan would have been motivated to attempt to profile a rough surface in order to have the ability and flexibility to measure various types of surfaces.

2. **Claim 15** is rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson '752 and McCullough as applied to claim 1 above, and further in view of Johnson (US 6,133,986).

Johnson '752 and McCullough show all the steps as described above but does not expressly show the lenslet array comprising an array of reflective elements each having a focusing power. Johnson '752 does however suggest the use of other types of optics provided they are "focusing elements" (column 7, lines 29-30).

Johnson, US 6,133,986 (Johnson '986) shows a confocal microscope using micromirrors (71) that have a focusing power .

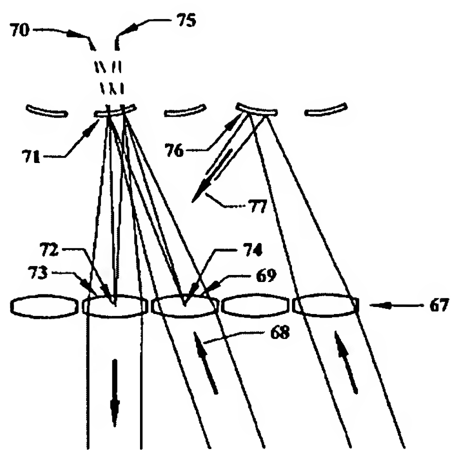


*FIG. 22*

At the time of the invention, one of ordinary skill in the art would have used micromirrors for focusing each spot since micromirrors meet the requirements that each element must have focusing power and in addition to the advantage that the arrangement of the optical elements can be more flexible.

3. **Claims 18 and 19** are rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson '752 and McCullough as applied to claims 1 above, and further in view of Harasaki et al (6,493,093).

As for **claim 18**, Johnson '752 and McCullough show all the steps including measuring an intensity signal at each of the detector elements as a function of the optical path length difference (column 1, lines 41+), but does not show the type of light source used and does not expressly show the varying an optical path length difference larger than a coherence length defined by the broadband source.

Harasaki et al show a Mirau interferometer having broadband source and varying an optical path length difference between the measurement and reference surfaces over a range larger than a coherence length defined by the broadband source.

At the time of the invention, one of ordinary skill in the art would have used a broadband light source and varied the optical path length larger than the coherence length in order to obtain good contrast fringes (column 1, lines17+).

As for **claim 19**, Johnson '752 and McCullough show all the steps as described above but does not show that the detector array is a CCD camera.

Harasaki et al shows the use of a CCD camera.

At the time of the invention, one of ordinary skill in the art would have used a CCD camera in order to image the interference of the measurement and reference beam onto each detector element of the detector array (column 5, lines 4+) since a CCD camera has the functional requirement of a multi-element detector.

4. **Claims 29-38, 40, 41, 43, 44, and 47-51** are rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson '752 and McCullough and further in view of Bopart.

For **claim 29** Johnson '752 shows a phase-measuring microlens microscopy comprising:

a multi-element detector (103); and

an interferometer which during operation directs a measurement beam to contact the measurement surface (106) and a reference beam to contact a reference surface (M), and images light reflected from the measurement surface to overlap on the multi-element detector with light

reflected from the reference surface, wherein the measurement and reference beams are derived from a common light source (109) and wherein the interferometer includes an optical system comprising a microlens array (102) to image the light reflected from the measurement surface onto the detector.

Johnson '752 does not expressly say that the microlens array has an array of lenslets. McCullough shows an illumination system and teaches that a microlens array comprises an array of lenslets. Therefore, at the time of the invention, one of ordinary skill in the art would have constructed the microlens array to have an array of lenslets in order for each lenslet to refract the light in the desired direction.

Furthermore, Johnson '752 does not expressly show the imaging with a magnification of less than 1.

Boppart et al show a method and apparatus for interferometric forward-directed optical scanning instruments wherein Boppart suggests the use of microlens array or group of lens for relaying and magnifying or demagnifying the image (column 31, lines 24+).

At the time of the invention, one of ordinary skill in the art would have been motivated to modify Johnson '752 so that the image is imaged with a magnification of less than 1 (demagnify), including magnifying the image or relaying with no magnification the image as currently shown by Johnson '752. One of ordinary skill in the art would have done so in order to image a larger portion of the sample with demagnification or image a smaller portion of the sample with greater detail with magnification, thus being able to image the required portion required detail of the sample.

As for **claim 30**, the lenslet array is positioned to generate a virtual image of the measurement surface in a virtual image plane (107).

As for **claim 31**, the optical system further comprises a detector imaging system (10) for imaging the virtual image in the virtual image plane onto the detector.

As for **claim 32** the optical system further comprises an object imaging system (101, 102) for imaging the measurement surface onto an intermediate image plane (107) adjacent the lenslet array.

As for **claim 33**, the object imaging system comprises a telecentric relay (101).

As for **claim 34**, during operation the system combines the light (column 4, lines 16+) reflected from the measurement surface with the light reflected from the reference surface and directs the combined light towards the lenslet array through the object imaging system.

As for **claim 35**, the object imaging system images the reference surface onto the intermediate image plane to overlap with the image of the measurement surface.

As for **claim 36** the lenslet array is positioned to generate a virtual image of the reference surface in the virtual image plane to overlap with the virtual image of the measurement surface, and wherein the detector imaging system images the overlapping virtual images of the

measurement and reference surfaces onto the detector.

As for **claim 40**, the optical system is selected to cause each element of the lenslet array to couple incident light reflected from the measurement object to a different one of the detector elements (column 3, lines 39-42).

As for **claim 41**, the lenslet array comprises an array of refractive elements (L) each having focusing power.

As for **claim 43**, the lenslet array comprises an array of diffractive elements each having focusing power (column 4, lines 5+)..

As for **claim 44**, an analyzer which during operation measures an intensity signal at each of the detector elements (column 3, lines 39+) and determines a surface profile of a measurement object based on the measured signals (column 2 lines 53+).

As for **claim 47**, Johnson '752 and McCullough show the interferometer further comprises a beamsplitter (BS), wherein the lenslet array (102) is positioned to accept an input beam from the light source and produce an intermediate beam comprising an array of sub-beams, wherein the beamsplitter is positioned to separate the intermediate beam into the measurement and reference beams, and wherein the lenslet array is positioned to cause the

measurement beam to contact the measurement surface as an array of focused spots corresponding to the array of sub-beams.

As for **claim 48**, Johnson '752 and McCullough show the lenslet array is positioned to generate a virtual image of the measurement surface in a virtual image plane (107), wherein each element (L) of the lenslet array images a region of the measurement object corresponding to a different one of the array of focused spots.

As for **claim 49**, Johnson '752 and McCullough show the interferometer further includes a mount (111) for securing an measurement object defining the measurement surface.

As for **claim 50**, Johnson '752 and McCullough shows a light source (109).

As for **claim 51**, Johnson '752 and McCullough does not expressly show the optical system matches an objective numerical aperture with an image numerical aperture, however, it would be obvious to one of ordinary skill in the art to arrange the apparatus so that the numerical aperture converter of the lens system matches an objective numerical aperture to an image numerical aperture based on the arrangement of Figure 1, and that Johnson '752 says each microlens is imaged on each detector pixel (column 3, lines 38+) where the projection aperture (107) is conjugate to the microlens focal points (column 4, lines 41+).

5. **Claim 42** is rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson '752, McCullough, and Bopart and as applied to claim 29 above, and further in view of Johnson '986.

Johnson '752 and McCullough show all the steps as described above but does not expressly show the lenslet array comprising an array of reflective elements each having a focusing power. Johnson '752 does however suggest the use of other types of optics provided they are "focusing elements" (column 7, lines 29-30).

Johnson, US 6,133,986 (Johnson '986) shows a confocal microscope using micromirrors (71) that have a focusing power .

At the time of the invention, one of ordinary skill in the art would have used micromirrors for focusing each spot since micromirrors meet the requirements that each element must have focusing power and in addition to the advantage that the arrangement of the optical elements can be more flexible.

6. **Claims 45 and 46** are rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson '752, McCullough, and Bopart as applied to claim 29 above, and further in view of Harasaki et al.

Johnson '752, Bopart, and McCullough combined show:

a light source (109),

scanning an optical path length difference between measurement and reference paths, and

measuring an intensity signal at each of the detector elements as a function of the optical path length difference.

Johnson '752 and McCullough show the function of a "positioning system" and an "analyzer" but do not expressly show the structure for performing the function. Furthermore, Johnson '752 and McCullough do not expressly teach the scanning range (light source coherence length).

As for Johnson '752 not expressly showing a structure for performing the function, since Johnson '752 shows the function, it would be obvious to have some type of structure for performing the function thus meeting the claimed limitation.

As for Johnson '752 not showing the scanning range, Harasaki et al shows a Mirau interferometer varying an optical path length difference between the measurement and reference surfaces over a range larger than a coherence length defined by the light source.

At the time of the invention, one of ordinary skill in the art would have scanned the optical path length difference larger than the coherence length in order to obtain good contrast fringes from a full scan as suggested by Harasaki et al (column 1, lines17+).

As for **claim 46**, Johnson '752, Bopart and McCullough do not expressly show that the multi-element detector is a CCD camera. Harasaki shows a CCD camera.

At the time of the invention, one of ordinary skill in the art would have used a CCD camera in order to image the interference of the measurement and reference beam onto each detector element of the detector array (column 5, lines 4+) since a CCD camera has the functional requirement of the multi-element detector.

7. **Claims 56 and 57** are rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson '752.

Johnson '752 shows an interferometric system comprising:

an interferometer (102) configured to receive a light beam from a light source (109) and generate an optical interference pattern; and

a lens system (101, 102) including a numerical aperture converter and at least one focusing element (107, 101), the lens system configured to transmit the light beam from the light source to the interferometer, the numerical aperture convert of the lens system configured to receive the optical interference pattern and forma a virtual image thereof, the at least one focusing element configured to image the virtual image of the optical interference pattern on a detector.

Johnson '752 does not expressly say that the numerical aperture converter of the lens system matches an objective numerical aperture of the lens system for illuminating the interferometer to an image numerical aperture of the lens system for imaging the optical interference onto the detector, however, it would be obvious to one of ordinary skill in the art to arrange the apparatus so that the numerical aperture converter of the lens system matches an objective numerical aperture to an image numerical aperture based on the arrangement of Figure 1, and that Johnson '752 says each microlens is imaged on each detector pixel (column 3, lines 38+) where the projection aperture (107) is conjugate to the microlens focal points (column 4, lines 41+).

### *Claim Rejections - 35 USC § 102*

1) The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2) **Claims 58 and 59** are rejected under 35 U.S.C. 102(b) as being anticipated by Hill (5,760,901).

Hill shows a confocal interference microscope comprising:

preparing, from a common source beam, a plurality of sub-beams;

relaying, using an optical system comprising at least one focusing element, a first portion of each sub-beam to a measurement surface and a second portion of each sub-beam to a reference surface;

combining light reflected from the measurement surface and light reflected from the reference surface; and

detecting the combined light.

3) **Claims 24-28, 53-64** are rejected under 35 U.S.C. 102(b) as being anticipated by Knuettel et al (US 5,962,852).

Knuettel et al show a process for determining analyte contained in a scattering matrix comprising:

directing a first portion of light to a measurement surface and directing a second

portion of light to a reference surface, the first and second portions of light being derived from a common source;

directing light reflected from the measurement surface and light reflected from the reference surface to a lenslet array;

forming a virtual image composing light reflected from the measurement surface and light reflected from the reference surface, the virtual image being spaced apart from the measurement and reference surfaces; and

imaging the virtual image onto a detector.

Papers related to this application may be submitted to Technology Center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the PTO Fax Center located in CP4-4C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The CP4 Fax Center numbers are 703-872-9306 for regular communications and for After Final communications

If the Applicant wishes to send a Fax dealing with either a Proposed Amendment or for discussion for a phone interview then the fax should:

a) Contain either the statement "DRAFT" or "PROPOSED AMENDMENT" on the Fax Cover Sheet; and

b) Should be unsigned by the attorney or agent.

This will ensure that it will not be entered into the case and will be forwarded to the examiner as quickly as possible.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew Hwa Lee whose telephone number is (703) 305-0538. The examiner can normally be reached on M-Th. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank Font can be reached on 703-308-4881.

Andrew Lee
Patent Examiner
Art Unit 2877

May 27, 2004/ahl